Nurses' knowledge, attitude and practice regarding infection control at neonatal departments in Benghazi public hospitals

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ABSTRACT

The acquisition and transmission of hospital-acquired infections (HAIs) can have a direct impact on the prognosis of neonates, the effectiveness of treatment, and posing significant challenges to clinical care. As nurses have direct contact with neonates, their knowledge, attitudes, and practices (KAP) are critical for the prevention and control of infection in neonatal intensive care units (NICUs). The purpose of this study was to assess the level of knowledge, attitude, and practice of infection control among nurses in neonatal departments in Benghazi public hospitals. A cross-sectional study was conducted between June and December 2021. A pretested questionnaire was used to collect data from 61 neonatal nurses. The collected data were reviewed, coded, and transferred to SPSS version 23 for analysis. The study found that about 55.7% of nurses had satisfactory knowledge. Nurses with bachelor's degrees had higher knowledge scores, were more likely to know the risks of acquiring HCV and HIV, and also showed good attitudes. In terms of practice, nurses with intermediate diplomas showed good practice, but no significant differences were found between the three groups (P = 0.5). Based on the results of this study, it can be concluded that the nurses in the current study have a good practice level and a positive attitude regarding infection control. However, their overall knowledge didn't reach a satisfactory level.

1. Introduction

Hospital-acquired infections (HAIs), also known as healthcare-associated infections, are infections acquired by patients during their stay in a healthcare facility, such as hospitals or clinics. These infections can be caused by bacteria, viruses, fungi, or other pathogens and can affect various parts of the body. HAIs are a significant concern in healthcare as they can lead to numerous adverse outcomes. One of the primary impacts of HAIs is the increased patient morbidity and mortality.

Consequently, the management of HAIs has emerged as a critical concern in the healthcare sector (WHO, 2015) ; (Vokes *et al.*, 2018) ; (Althiyabi *et al.*, 2024). More than half a million newborns die from infections each year, the large majority occur in low and middle income countries (LMIC) (UNICEF,

2020); (Sharrow, 2021); (Jones & Nunes, 2022), such as Ethiopia which still faces high neonatal and under-five mortality rates, highlighting the need for continuous investigation and interventions (Daniel *et al.*, 2017); (Abraha et al., 2020). Nurses play a crucial role in preventing and controlling the spread of HAIs in the neonatal unit. It is important for nurses to have sufficient knowledge, attitude, and practice in infection prevention and control. Several studies have highlighted the importance of training interventions in enhancing nurses' knowledge and perception of infection control practices (Shah *et al.*, 2022); (Julius, 2022); (Sukhbir *et al.*, 2023). Factors such as self-identification as at-risk individuals, self-justification, commitment, and information-seeking have been identified as influential in nurses' adherence to infection prevention and control

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measures (Suarnianti *et al.*, 2016); (Lim *et al.*, 2021).

Adequate knowledge and adherence to standard infection prevention practices play a crucial role in reducing HAIs. However, research indicates that less than half of nurses possess sufficient knowledge and about two-thirds have good practices in preventing HAIs (Sisay *et al.*, 2023) (Foga Sebro *et al.*, 2023). A study found that 88% of nurses reported high exposure to biohazards, particularly needle stick injuries. Most nurses lack adequate knowledge and practice of infection control (Mukhtad *et al.*, 2019; Elfaitouri *et al.*, 2023). A descriptive cross-sectional study was conducted among 28 physicians, nurses and laboratory scientists in the Neonatal Intensive Care Units (NICU) of Misurata teaching hospital, Libya. The results reveal that the participants had inadequate knowledge and poor compliance with standard precautions of infection control among NICU health-care staff (Ismail & Mostafa, 2016). According to a study done at Sabha, Murzug, and Traghen Hospitals, found that although the hospital staff members including nurses knew basic precautions well, but they didn't always follow them in their daily work (Abdallha, 2018. This indicates a gap between their knowledge and implementation of these precautions. Addressing this gap is crucial for improving patient safety and reducing the risk of healthcare-associated infections (Abdallha, 2018; Mukhtad *et al*,.2019; Elfaitouri *et al.*, 2023; Althiyabi *et al.*, 2024). Hence, the aims of this study were to assess the level of nurses' knowledge, attitude, and practice regarding infection control at neonatal departments in Benghazi public hospitals (Benghazi Medical Centre (BMC) and Children's Hospital). Additionally, to understand the factors that influence these outcomes in order to provide evidence supporting the development of infection control programs in hospitals.

2. Methodology

2.1. Study design:

The current study employed a descriptive research study using a cross-sectional survey design to reduce bias and focus on the characteristics of a single group without trying to make interference.

2.2. Study area and period:

The study was conducted from June to December 2021 in the BMC Neonatal departments and the children's hospital.

2.3. Population and sample size:

All 72 nurses working in both hospitals were selected, most of them working in BMC (52 nurses), and 20 nurses in the children's hospital. The nurses responsible for the neonatal department of each hospital received a letter with a description of the survey and requesting consent for the nurses to participate. Consent to participate was implied by the return of the completed questionnaire.

Data collection tools: In this study, the researcher used the questionnaire, consistent with the study objectives, to assess nurses' knowledge, practice, and attitude regarding infection control. The questionnaire was translated into Arabic, using simple basic questions and statements to enhance clarity since the nursing education in an intermediate institute of nursing in Libya is carried out using the Arabic language. This questionnaire was formulated and developed by previous study (Parmeggiani, *et al.*,2010), in which the content, comprehensibility, clarity, and format were developed and validated on the input of a volunteer sample of thirty healthcare workers in a small pilot test.

The questionnaire comprised four categories of questions :(1) socio-demographic characteristics such as age, education level, and experience; (2) knowledge about the risks of acquiring and/or transmitting certain HAI for/to a patient and standard precautions for prevention; (3) attitude toward precautionary guidelines and perception of the risk of acquiring HAI; and (4) practice of standard precautions [Appendix1]. It was modified where necessary.

2.4. Statistical analysis:

Multivariate logistic and linear regression models were used to assess the independent associations between predictor variables and

the following outcomes: Model 1: Nurses' knowledge of the risk of acquiring HCV and HIV infections from patients. Model 2: Nurses' awareness of using standard precautions and hand hygiene as measures to control HAIs. Model 3: Nurses' perception of the risk of acquiring HAIs from patients. Model 4: Nurses' frequency of using gloves during direct patient contact and practicing hand hygiene after glove removal. One-way ANOVA was employed to examine mean differences among education level groups. All tests were two-tailed, with a significance level set at 5% ($p < 0.05$). Responses were coded as 1 for correct answers and 0 otherwise. The level of knowledge, practice, and attitude was assessed according to the scales developed by Alhag (2017). Data analysis was conducted using the SPSS program version 23.

2.5. Ethical considerations:
The study protocol as well as the questionnaire were approved by the department of health services administration and the coordinator of postgraduate studies at the public health faculty. Conducting the study in the hospitals was approved by the administration and neonatal departments of BMC and the children's hospital . No identifying information was requested from participants, to protect their privacy. The plan was discussed with the head nurses of the units and an explanation was given about the purpose of the study and the ethical aspect of the survey to collect the data from their staff.

3. Results

3.1. Response rate and Socio demographic characteristics:

Of the 72 questionnaires distributed, a total of 61 respondents returned the questionnaire with a final response rate of 84.72 %, all of whom were female, as shown in Table 1. Regarding the attendance of training courses, around 56% of the studied sample never attended any training programs or courses regarding infection control, which in turn increases the risk for both patients and nurses.

3.2 Evaluation of knowledge, attitude and practice related to HIAs in relation to qualification
Table 2 shows the results of the means of the

Table 1: Socio-Demographic characteristics of respondents (n=61)

Variables	Frequency	%
Age (years)		
20 – 25	12	19.7
26-31	18	29.5
32-37	23	37.7
≥ 38	8	13.1
Marital status		
Single	34	55.7
Married	27	44.3
Education level		
Higher Diploma	25	41.0
Intermediate Diploma	28	45.9
Bachelor of Nursing	8	13.1
Years of practice		
1 -5	39	63.9
6-10	9	14.8
11- 15	2	3.3
≥15	11	18.0
Hospital		
BMC	43	70.5
Children	18	29.5

nurse's knowledge, attitudes, and practice in relation to their qualification. No significant statistical differences were found between the three groups. It reveals that nurses who had bachelor degrees displayed higher mean knowledge and attitude scores (12.5 from a total 20 questions and 2.99 from a total 3 questions) respectively as compared to the other two groups that had higher and intermediate diploma, but that nurses who had intermediate diploma displayed higher mean (12.1 from a total 14 questions) as compared to the other two groups.

value >0.05 (Model 2). This behavior was more frequent in nurses who knew that hand hygiene after removing gloves was a HAI control measure (OR =15.2, 95% CI 0.91-25.6) (Model 4). In general, the p-value in models 1, 2, and 4 (0.11, 0.34, and 0.3) had no significant difference.

3.4 The association between nurses who perceive a risk of acquiring a HAI from a patient and the various explanatory variables:

The linear regression analysis regarding the association between the nurses who perceive a risk of acquiring a HAI from a patient and the

Table 2: One-way ANOVA for comparison of the knowledge, attitudes, and practice related to HIAs scores according to their qualification

Variables	Mean ± SD	ANOVA P-value
Knowledge Scores (total score = 20)		
Higher Diploma (n=25)	11.4 ± 2.4	F = 2.1 (P=0.1)
Intermediate Diploma (n=28)	10.6 ± 2.3	
Bachelor of Nursing (n=8)	12.5 ± 2.1	
Attitudes Scores (total score = 3)		
Higher Diploma (n=25)	2.7 ± 0.8	F = 0.59 (P=0.5)
Intermediate Diploma (n=28)	2.9 ± 0.41	
Bachelor of Nursing (n=8)	2.99 ± 0.001	
Practice Scores (total score = 14)		
Higher Diploma (n=25)	11.6 ± 2.6	F = 0.59 (P=0.5)
Intermediate Diploma (n=28)	12.1 ± 1.8	
Bachelor of Nursing (n=8)	11.8 ± 2.2	

3.3 The association between the different outcomes of interest and the various explanatory variables:

Table 3 shows the results of the multivariate analysis regarding the association between the different outcomes of interest and the various explanatory variables. Nurses with higher education (OR = 3.8, 95% CI 1.4–10.4) were more likely to know the risk for a nurse of acquiring both HCV and HIV from a patient (Model 1).

The vast majority correctly identified as having proper HAI control measures with variables p-

various explanatory variables is shown in Table 4. The p-value of model 3 is (0.02); there is statistical significance. Statistical significance is found in the following variables: not knowing the risk for Healthcare workers (HCWs) of acquiring HCV infections from a patient and fewer number of years in practice (0.006, 0.01) coefficients (-1.440, -0.544), respectively. There is no direct effect between other variables and nurses who perceive a risk of acquiring a HAI from a patient.

Table 3: Multivariate logistic regression models (1, 2, 4) results

	Odd Ratio	95% CI	P
Model 1: Nurses who know the risk of acquiring HCV and HIV infections from a patient			
$\chi^2 = 9.01$, (5 df), P = 0.11			
Longer number of years in practice	1.3	0.69-2.5	0.4
Need of additional information about HAIs	0.59	0.1-3.9	0.5
Higher Educational	3.8	1.4-10.4	0.008
Know the risk for a HCWs of transmitting HCV infections to a patient	1.6	0.41-6.1	0.5
Younger age	0.71	0.34-1.5	0.3
Model 2: Nurses who know that using standard precautions and hands hygiene after removing gloves are HAI's control measures			
$\chi^2 = 4.2$, (4 df), P=0.34			
Not know the risk for a HCWs of transmitting HCV infections to a patient	1.4	0.5-5.6	0.8
Not know that HCWs hands are vehicle for transmission of nosocomial pathogens	0.44	0.06-1.7	0.7
lower Educational	0.31	0.05-1.8	0.1
longer number of years in practice	1.31	0.27-6.3	0.7
Model 4: Nurses who often or always use gloves when at direct contact with a patient and performed hands hygiene measures after removing gloves			
$\chi^2 = 10.3$, (9 df), P=0.3			
Know that hands hygiene after removing gloves is a HAIs control measure	15.2	0.91-25.6	0.06
Not know that invasive procedures are a risk factor for HAI	0.82	0.12-5.3	0.8
Higher Educational	1.02	0.34-3.1	0.9
Know the risk for a HCWs of acquiring HCV infections from a patient	1.4	0.26-7.1	0.7
Know the risk for a HCWs of acquiring HIV infections from a patient	1.5	0.30-7.2	0.6
Higher perceived risk for a HCWs of acquiring a HAI	1.4	0.90-2.1	0.1
Beliefs that the use of guidelines for HAIs control practices do not reduce the risk	7.5	0.31-17.9	0.2
Not know the risk for a HCWs of transmitting HCV infections to a patient	0.65	0.12-3.5	0.6
Older age	1.4	0.68-3.1	0.3

χ2: chi-square test, 95% CI: 95% Confidence Interval for Mean; P<0.05 is statistically significant

Table 4: Linear regression analysis model 3 results

	Coefficients	t	P
Model 3: HCWs who perceive a risk of acquiring a HAI from a patient			
F(7,53)=2.6, P=0.02, R Square=0.26, Adjusted R Square=0.16			
Need of additional information about HAIs	-0.256	-0.390	0.6
Lower Educational	- 0.401	-1.064	0.3
Not know that HCWs hands are vehicle for transmission of nosocomial pathogens	-0.185	-0.228	0.8
Know the risk for a HCW of transmitting HCV infections to a patient	0.662	1.290	0.2
Fewer number of years in practice	-0.544	-2.593	0.01
Not Know the risk for a HCW of acquiring HCV infections from a patient	-1.440	-2.893	0.006
Know the risk for a HCW of acquiring HIV infections from a patient	0.593	1.229	0.2

Table 5: comparison of the knowledge, attitudes, and practice related to healthcare-associated infections grade

	No.	%
Knowledge		
Excellent	3	4.9
Good	6	9.8
Satisfactory	34	55.7
Poor	17	27.9
Unacceptable	1	1.6
Attitudes		
Excellent	57	93.4
Good	1	1.6
Unacceptable	3	4.9
Practice		
Excellent	46	75.4
Good	7	11.5
Satisfactory	6	9.8
Poor	1	1.6
Unacceptable	1	1.6

3.5 *Comparison of knowledge, attitude, and practice related to HIAs:*

Table 5 shows the results of the comparison of knowledge, attitude, and practice related to healthcare-associated infections grade among the number of nurses in the neonatal departments.

4. Discussion

According to the socio-demographic characteristics, the majority of the respondents were between the ages of 32 and 37 years old, single, and had an intermediate diploma. This finding is in concordance with that of study conducted by Chitimwango, which studied knowledge about standard precautions of

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infection prevention and control within a tertiary hospital in Zambia (Chitimwango, 2017). The same general picture was reflected in a study conducted on Cypriot nurses' commitment to the best practices for preventing exposure to pathogens (Efstathiou et al.,2013). Additionally, other study about knowledge and compliance with standard precautions found that the mean age was slightly lower (Labrague et al., 2012). In general, the current study revealed that there is (55.7%) poor knowledge, excellent attitude (93.4%), and good practice (75.4%) related to healthcare-associated infections, and this reflects the declining level of knowledge in nursing, this is similar to study conducted at the Intensive Care of a selected Cancer Hospital in Egypt (Eskander et al., 2013).

Concerning level of education, most of the studied sample had an intermediate diploma and a low knowledge level regarding modes of transmitting diseases. This finding is in agreement with that of Mukhtad et al., who have assessed the knowledge, attitudes, and practices of nurses regarding the infection control program at El-Hawwary Renal Dialysis Centre in Benghazi City (Mukhtad et al., 2019).

Regarding the statement about wearing protective eyewear when in direct contact with a patient, 60.7 % of the studied sample did not wear protective eyewear due to their unavailability from the hospitals, which similar to Mukhtad et al., 2019. It is difficult to determine with certainty whether the responses reflect what nurses actually do. The great majority of the studied sample had an excellent practice level (98.4%) about recapping needles after using and placing needles in sharp's containers. Although the error was knowledge about how blood-borne diseases are transmitted, the reported practice had been high. In this regard, the study reported that most needle stick injuries occurred while

recapping the syringe after use (Abd al-Raziq et al., 2018; Ebrahimi & Khosravi 2023; Haji et al., 2024). Compliance with infection control measures is highly dependent on personality compliance, which may increase when personal safety is threatened (Eskander et al., 2013). According to WHO, a huge gap still exists between the knowledge accumulated over the past decades and the implementation of infection control practices (WHO, 2015). This gap is deeper in poor-resource conditions, with devastating consequences (Chitimwango, 2017).

The results of the current study indicate that the majority of the sample answered yes with the sentence Do you feel that you need additional information regarding infection control? and this reinforces their poor knowledge.

The study found no statistically significant difference in the levels of knowledge, practice, and attitude towards infection control among nurses of different educational qualifications. While nurses with bachelor's degrees showed higher knowledge scores compared to those with higher and intermediate diplomas, they did not exhibit the highest level of practice when compared to the other two groups. This highlights the importance of improving the knowledge of nurses with higher and intermediate diploma qualifications. These findings agree with previous study that found a significant statistical difference in knowledge and no significant statistical difference in practice scores (Fashafsheh et al., 2020). In spite of having higher knowledge scores than the other two nursing qualifications, master's degree nurses didn't reach satisfactory practice scores either, this is in line with the results revealed by Eskander et al., 2013). Consequently, the studied sample had satisfactory performance scores, which were significantly higher among bachelor's degree nurses than in the other two nursing qualifications.

Looking at table 2, although there is no relationship between nursing knowledge and the three levels of education, the difference in representation with the bachelor group, which represents 8 out of 61 compared to the high and intermediate diploma, if the number of the bachelor sample is more in the study sample is higher, the result of knowledge regarding infection control will be different.

Their attitudes towards infection control are logical and positive, and this reinforces their desire to learn more knowledge about infection control and supports their excellent practice. Although there is no statistical significance in model 1, there are statistically significant differences in knowledge at the highest educational level about HCWs who know the risk of acquiring HCV and HIV infections from a patient.

In model 2, there is no statistical significance between variables and outcomes. In model 4, knowing that hand hygiene after removing gloves is a HAI control measure was found to be a significant determinant of the amount of knowledge about HCWs who often or always use gloves when in direct contact with a patient and perform hand hygiene measures after removing gloves. In model 3, nurses who perceive a risk of acquiring a HAI from a patient were found to have a significant difference and relationship between variables (fewer number of years in practice and not knowing the risk for a HCW of acquiring HCV infections from a patient) and outcome.

In general, there is no direct relationship between variables and outcomes. Although this response rate does not reflect the internal validity of the findings, it may decrease the overall generalizability of the results to all nurses in the neonatal department. However, because nurses tend to be relatively homogeneous concerning attitudes and behaviors, the response rate may not have led to significant non-response bias (Parmeggiani *et al*., 2010).

5.Conclusion

The findings of this study concluded that nurses in the current study have good practice levels and positive attitudes regarding infection control. However, despite knowing about infection control, their overall knowledge didn't reach a satisfactory level. Subsequently, there might be a risk of infection transmission, which leads to an increase in hospital-acquired infection rates.

Conflict of Interest
No conflict of interest was declared by the authors.

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APPENDIX 1
Survey Form

Socio- demographic data:
1-Sex :
1- Male ( )   2- female ( )

2- Age :
1- From 20 – 25 yrs ( )   2- From 26-31 yrs ( )
3- From 32-37 yrs ( )   4- Above 38 yrs ( )

3- Social status :
1- Single ( )   2- Married ( )

4-years of experience in neonatal department:
1- From 1 year -5 yrs ( )   2- From 6-10 yrs ( )
 3- From 11- 15 yrs ( )   4- More than 15 yrs ( )

5- level of education :
1- Higher Diploma( ) 2- Intermediate Diploma
3- Bachelor of Nursing ( )

6- Have you received any training program on infection control?
Yes( )   No ( )

This section is designed to explore your knowledge related to health care associated infections
1-Which of the following infections a health care worker can acquire from a patient? <u>check one or more</u>
a- Hepatitis B ( ) b- Hepatitis C ( ) c- Tuberculosis ( ) d- Influenza ( )
e- Measles ( ) f- Human immune deficiency( )

2- Which of the following infections a health care worker can transmit to a patient? <u>check one or more</u>
a- Hepatitis B ( ) b- Hepatitis C ( ) c- Tuberculosis ( ) d- Influenza ( )
e- Measles ( )

3- Which of the following infections can be serious on neonate ? <u>check one or more</u>
a- Meningitis ( )   b- Sepsis ( ) c- Omphalitis ( ) d-Ophthalmia ( )

4-* For each statement regarding health acquire infection , please check whether you agree, are uncertain or disagree :

Statement	Agree	Uncertain	Disagree
1-hands hygiene after removing gloves is a health acquire infection control measure			
2- changing mask before going to another patient is a health acquire infection control measure			
3- wearing gloves , mask, and protective eyewear are a health acquire infection control measure			
4- invasive procedures are a risk factor for health acquire infection			
5- health care workers hands are a vehicle for transmission of nosocomial pathogens			

Attitudes section of the questionnaire:

This section is designed to explore your attitudes towards HAIs. For each statement check whether you agree, are uncertain or disagree

Statement	Agree	Uncertain	Disagree
1- The use of guidelines for HAIs control practices reduce the risk			
2- Hands hygiene measures reduce the risk of HAIs among patients			
3-Hands hygiene measures reduce the risk of HAIs among HCWs			

This section is designed to gather information about your practice

Check how often do you adopt each of the following practices to reduce the risk of a health acquire infections:

Statement	always	Often	Sometimes	Rarely	Never
1- hands hygiene measure before starting the working activity					
2- hands hygiene measure before going to another patient					
3- hands hygiene measure before wearing gloves					
4- hands hygiene measure after removing gloves					
5- wearing gloves when at direct contact with a patient					
6- changing gloves before going to another patient					
7- wearing protective eyewear when at direct contact with a patient					
8- wearing mask when at direct contact with a patient					
9- recapping needles after using					
10- placing needles in sharp's containers					
11- using syringes with retractable needle					
12- using syringes with protective shield					
13-using scalpels with protective shield					
14-using intravenous cannulation with retractable needle					

Do you feel you need more information about HAIs?
Yes ( )   No ( )